



**Instrumentation
Through
Innovation**

Universal embedded microcontroller trainer kit

Spectrochem Instruments Pvt. Ltd.

**Our new version-2.0 trainer kit now supports
more than 250 interface experiments.**

Supports: CISC & RISC

ATMEL 8051 controllers

- (a) AT89S51
- (b) AT89S52
- (c) AT89S55

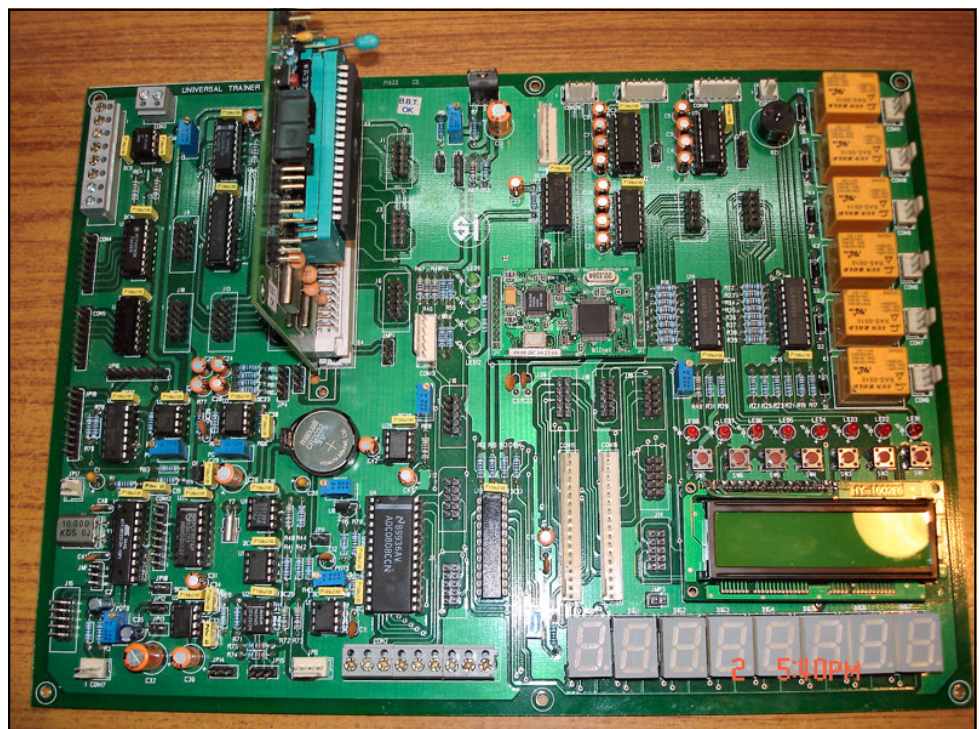
ATMEL AVR controllers

- (a) AT90S8515
- (b) ATMEGA8515
- (c) ATMEGA161
- (d) ATMEGA162
- (e) AT90S8535
- (f) ATMEGA8535
- (g) ATMEGA163
- (h) ATMEGA16
- (i) ATMEGA32

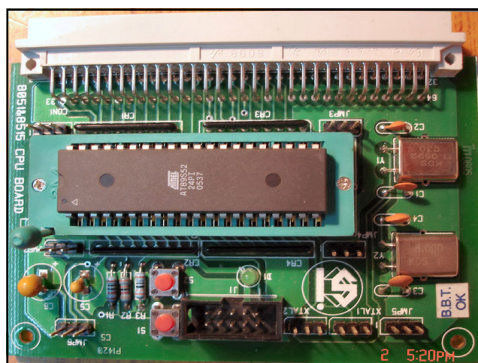
MICROCHIP 16F877

Special points of interest:

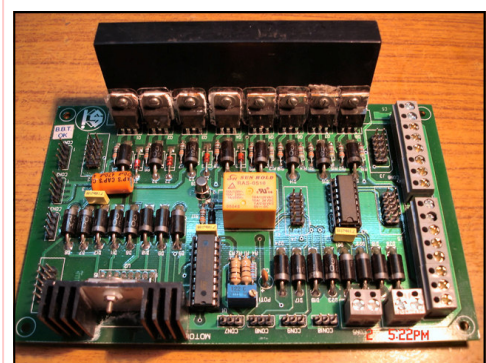
- * Over 250 experiments
- * IR communication RC5
- * Ethernet interface
- * Fastrack GPS interface
- * GSM interface
- * RS232 & RS485
- * Dallas 1Wire bus
- * IIC, SPI serial interface
- * ADC, DAC, PWM
- * Stepper, DC & servo control
- * Alpha numeric & Graphic LCDs



The universal microcontroller kit supports multiple microcontroller families, the specific microcontroller card only needs to be plugged in to the 64 pin EURO socket.

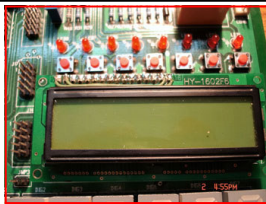


The AT89S51 & ATMEGA8515 CPU card

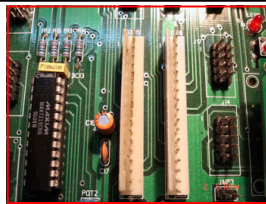


The STEPPER, DC & SERVO motor interface

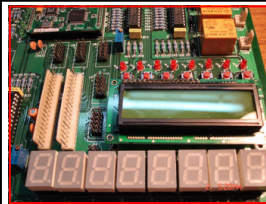
User interface: Alpha numeric, graphic LCD, 7 seg displays, LED's, RTC, EEPROM



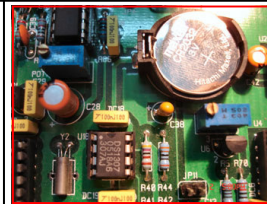
16 X 2 Alphanumeric LCD



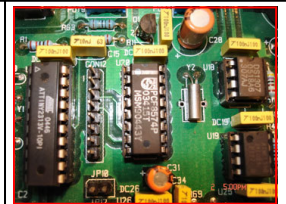
KS108 & T6963C Graphic LCD



Eight 7-segment LED display



RTC DS1307 with Battery



IIC EEPROM AT24C08

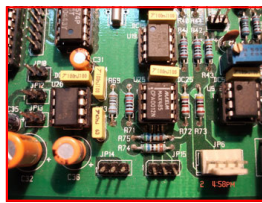
Alphanumeric LCD interface is available in 4 bit mode & 8 bit mode, the board is fitted with a 16 X 2 LCD with backlight. Two types of Graphic LCD's 128 X 64 are supported, graphic LCD's require 8 bit interface & also some additional lines. All the necessary hardware is provided on board for the three type of LCD's. The LED's are provided with current limiting resistor & driving transistor. Bipolar transistor array ULN2803 is used for driving the LED's. The eight seven segment LED display is driven by just 3 I/O lines using MAX7219 SPI bus interface.

Conventionally it would have required at least 12 I/O lines and BCD driver chips like CD4511. Real time clock DS1307 & EEPROM AT24C08 share a common two wire interface (IIC bus) also called the TWI interface. The SCL & SDA lines are the only two lines required to complete the interface. The RTC is also fitted with a 3V battery back-up to maintain time even when the power is disconnected. Up to eight same devices can exist on the IIC bus, however many other different devices can also co-exist.

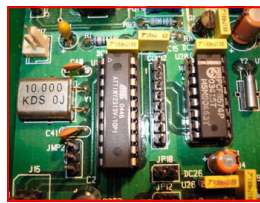
Communication: RC5, RS232, RS485, GPS, GSM, Ethernet & Dallas 1Wire



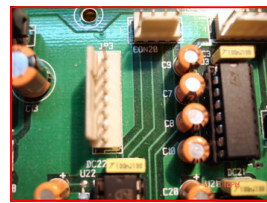
Serial ETHERNET gateway



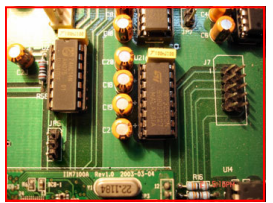
RS485 serial interface



RC5 IR RX & TX



FASTRAX GPS receiver



GSM interface

RC5 is a television IR communication standard (Developed by Phillips) used in remote controls. The ATTINY2313 controller is programmed for both RC5 IR decoding as well as IR transmission.

"Synchronous serial communication protocols like IIC, SPI & MICROWIRE reduce the PCB real estate thus saving power & I/O lines"

Other television remote control standards are RC80 & SONY SIRC, these signals also can be easily decoded. We can program the TINY2313 chip for these standards if you desire.

Asynchronous communication standards like RS232 & RS485 are provided on board with all the necessary hardware. The GPS interface employs RS232 serial communication employing NMEA protocol for data display.

The communication between the GPS & microcontroller should be at 4600 baud. Similarly the GSM communication interface too employs the RS232 interface, however here the GSM module can support up to 115Kbps. The protocol employed for interface is the GSM AT command set. Though the AT command set is standardized some commands are specific to the GSM module being used.

RS232 communication can be implemented in full duplex mode or half duplex mode, generally is always used in full duplex mode. The limitation of RS232 communication is that the cable length must be limited to 10 meters. Moreover as per RS232 standard it is meant for communications between two devices

only. However, in industrial systems, data need to be transmitted over great distances typically up to even a kilometer. It also is required to network many measurement & control points. The best interface for such systems is the RS485 multi-drop network. It can transmit data over 4000 feet (1.3 Km approx), multiple devices can be connected on just three conductors, however RS485 is a half duplex system.

The RS232 serial ETHERNET gateway accepts data through the Rs232 serial interface, it packets the data into a TCP/IP stream & transmits out to the LAN network. The board supports DHCP or a configurable IP address. Link status is also provided through four status LED's.

Dallas 1Wire network requires only a single line for data interchange, the same line that powers the system also carries the data, the other line is common ground. This interface was developed by Dallas semiconductors for popular iButton interface.

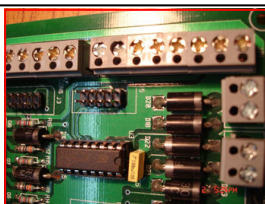
Motor control: Uni-polar, Bi-polar steppers, DC motors, SERVO's & buzzer



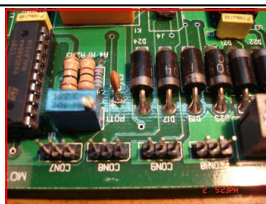
Uni-polar stepper motor drive



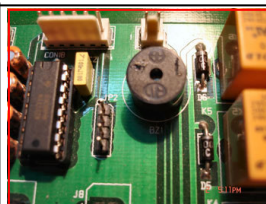
Bi-polar stepper motor driver



L293 DC motor driver



Hobby DC servo motor driver



Piezo Buzzer

Motor control & interface is available on our multi-motor interface card. The uni-polar stepper motor interface employs four discrete NPN darlington transistors with protection diode circuitry. Four bits of microcontroller are required for stepper motor interface. The stepper is usually driven in a two phase excitation, full step mode for good torque characteristics.

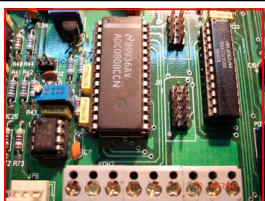
A eight wire unipolar motor can also be configured as bi-polar drive. Bipolar drive offers typically 60% better torque than uni-

polar drives. Here the driver is implemented using L297 & L298 (H-Bridge) driver. In bi-polar drive mode, the motor drive voltage is typically double of uni-polar operation.

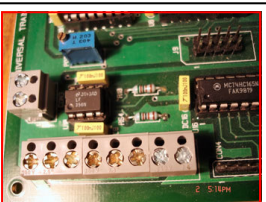
The DC motor control is possible through PWM & L293 H-Bridge driver, bi-directional DC motor control is also possible. PWM can either be implemented using software routines or employing on-chip hardware.

DC servo motors are used in RC hobby circuits for navigation.

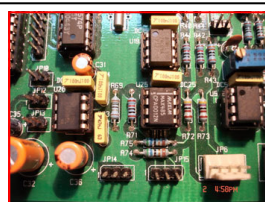
Analog: ADC, DAC, PWM, PWM DAC, Audio Amplifier, IR reflectance probe



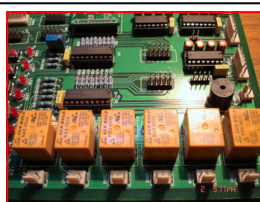
Eight bit ADC 0808



Eight bit DAC 0808 with I to V



Audio amplifier with LM386



Six 3ms S.P.D.T Relays

TCRT9000 is an IR trans-reflectance sensor. It contains an IR emitter & a detector in the same package. The sensor can be used in proximity detector applications. It can also be used in projects like line follower robot.

The board also features six fast acting 3ms S.P.D.T relays & a solid state Relay. All the output connections, C, N.C & N.O are available for connections. ULN2803 bipolar NPN transistor array is used to drive these & the buzzer.

The Analog to Digital converter provided here is the parallel interface type ADC0808. This is an eight bit device with eight channels. Eight data lines & three control lines are required to interface this chip. Also a clock source is required, a 555 timer is employed here for providing the required clock.

All the eight analog inputs are available through a screw wago connector. A voltage divider, Photo transistor or a temperature probe with signal conditioner may be interfaced as experiments. By interfacing relays or the SSR a complete control system too can be easily built.

The digital to analog converter is DAC0808, an eight bit, single channel, current output device. The reference voltage & $\pm 12V$ required to operate are also connected. A I to V converter is also built using LF356. The eight bit interface is connected to a latch, 74LS373.

DAC are employed in feedback systems. The ADC & the DAC can be implemented in a simple total feedback control loop application. Another example is in building a P.I.D controller.

PWM or pulse width modulation is available on the RISC CPU's such as AVR & PIC. Usually 10 bit PWM hardware is associated with one or two timers on the chip. The PWM signal can be employed for efficient DC motor speed control. It is also used in the Inverter technology to produce true sine wave output. A DAC can be built using PWM and a low pass filter. All the necessary hardware including the buffer opamp is provided on board. We also have included a voltage doubler using two opamps for boosting the PWM DAC output to 0-10V. PWM can also be used to produce musical notes.

We also have affordable general purpose microcontroller experiment boards priced at Rs 3500/- only.

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Spectrochem Instruments (SCI) was incorporated in 1996. At SCI we design & develop a wide variety of special accessories and instruments used in analytical Chemistry, Medical & Bio-Technology, Lab & Process automation, Environmental engineering. We have to our credit products which became import substitutes for a number of Accessories for ATOMIC ABSORPTION SPECTROMETER.

We work with more than 80 microcontrollers across four families from leading microcontroller manufacturers such as...

89SXX (8051 core, Silicon labs, ATMEL, Phillips etc)

ATMEL AVR (complete family from Tiny to Mega)

PIC (10F, 12F, 16F, 18F & DS PIC)

TI MSP430

Our 12+ years experience in embedded systems, Industrial automation & control systems helped us design a unique totally practical oriented embedded systems course for meeting the industry's ever growing requirement for embedded professionals.

Check out this course at our website...

www.enggstudentprojects.com

Programming: Building embedded applications, choice of languages

Building applications for embedded systems requires tools like assembler/compiler, debugger etc. Embedded systems can be programmed using the micro specific assembler, however this is quite tedious for product development where the code is quite large.

A number of high level languages are available for code development. The compilers come with an integrated development environment (IDE), featuring, compiler, text editor, simulator, debugger & programmer.

Popular High level language compilers...

- (a) BASIC
- (b) "C"
- (c) "FORTH"
- (d) PASCAL

(e) Ada

For 8051 & ATMEL AVR best BASIC compiler is BASCOM-8051 & BASCOM-AVR from MCS electronics holland

Llly the best "C" compiler for 8051 is RIDE & for AVR is CAVR.

For microchip PIC & dSPIC...

- (a) PIC BASIC Pro from ME labs
- (b) PROTON SUITE from Crown hill co UK
- (c) MikroBASIC, MIKROC & MIKRO PASCAL from mikroelektronika
- (d) Best "C" compiler for PIC is FED PIXE from Forest electronics.

The tool chain preference differs from user to user. We have put here the ones which a student or a beginner can afford

& at the same time is comfortable with the tools. Also Most of the compiler manufacturers listed here give generous evaluation versions.

They are all reasonably priced & affordable. Good working examples are provided & large user forum also exist.

We provide a two day training program for all education institutions buying at least 5 of our kits free of cost. The kit is supported with a good user's manual which is well illustrated & introduces the interface standards in simple & lucid manner.



Madhav Tenneti
Managing Director